平成21年度重点プロジェクト事業（海外派遣研究員等旅費）報告

国際バイオメカニクス学会における研究発表について

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国際バイオメカニクス学会（International Society of Biomechanics）は2009年にSouth AfricaのCape Townで７月５日から９日まで開催された。発表演題数は560題に及び日本から33演題であった。本学会は身体運動に関する国際学会であり，例年新しい基礎及び応用に関する研究成果が発表されている。世界のスポーツ競技場面での基礎研究から応用まで，バイオメカニクス及び運動生理学的手法により広く映像・コンピュータ等を援用した研究が公表される。よって他大学の研究者との交流が可能となり，本学の国際共同研究推進に役立ち，ひいては国際競技力向上に貢献すると考えられる。これまでスポーツ科学，コーチ学各領域では個別にパフォーマンス向上について研究がなされてきたが，今回は，統合した視点から筋力向上，腹圧，呼吸に関する発表を行った。テーマはSPONTANEOUS BREATH VOLUME AND INTRA-ABDOMINAL PRESSURE DEVELOPMENT WERE RELATED WITH MAGNITUDE OF ISOMETRIC LIFTING EFFORTであり，内容は以下のとおりである。

Intra-abdominal pressure (IAP) linearly increases with increased lifting effort to stabilize lumbar spine during lifting [1, 2]. It is known that IAP development was influenced by breath volume, for instance, IAP development was highly elevated as a voluntary respiratory action in inhaling, then, breath holding prior to lift-off [3]. However, it is unknown whether changes in spontaneous breath and IAP development are coupled with lifting effort. The purpose of the present study was to examine changes in spontaneous breath and IAP development with increased isometric lifting effort.

Eleven men (22 ± 2years) performed isometric lifting tasks with straight arms and legs, with gripped handle at 2.5cm proximal to the patella, using a lifting device attached load cell at 30%, 45%, 60%, 75%, 90%, 100% of maximal lifting effort, three times for each, in a random order. Subjects practiced the required lifting effort before data collection. IAP was measured with pressure transducer placed intra-rectally, 15cm from the anus [4]. Breath volume was measured by using a pneumotachometer from a face mask. The volume of one inspiratory before just lifting and expiratory volume for a period of 2 s just after the start of lifting were normalized by tidal volume at rest. The change of IAP development was calculated from at rest up to peak during lifting. The subjects were blinded so as not to bias their respiratory behavior. Independent variable was lifting effort. Dependent variables included the respiratory volume parameters and IAP development. Repeated measures ANOVAs were performed to assess statistical significance. Dunnet post hoc performed to assess the significant change compared to tidal volume on these respiratory dependent variables. Changes in spontaneous respiratory volume normalized by the tidal volume. Asterisk indicates significant differences from the tidal volume for $p < 0.05$.

A lifting effort had a main effect of the all dependent variables ($p<0.05$). At 30%-100% of

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maximal lifting effort, the normalized inspiratory volume was increased to 111.7±16.6%, 143.5±15.5%, 161.1±15.4%, 191.9±19.6%, 206.8±15.2% and 235.7±20.8%, by contrast, the normalized expiratory volume was decreased to 50.7±12.7%, 27.6±9.9%, 18.2±7.7%, 13.2±6.3%, 7.2±2.1% and 5.1±1.3%, respectively (mean±SE) (Figure 1). Based on the Dunnet test, the inspiratory volume significantly increased and the expiratory volume significantly decreased compared to tidal volume at lifting effort above 45% and 30% of maximal lifting effort, respectively. The IAP development significantly increased to 18.6±3.2, 35.9±5.6, 49.3±6.3, 72.1±8.8, 95.7±12.4 and 109.6±13.9 (mmHg) respectively. These results suggested that the natural respiratory coupled with lifting effort would be controlled to carry out in efficient manner [5]. Also, both increasing inhalation and avoiding excessive exhalation would be necessary to obtain an effective respiratory mechanism for IAP development [3].

Natural IAP development and respiratory volume are tightly associated with isometric lifting effort.

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